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CONSTRUCTION CONTRACTING
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Term Paper

Factors affecting Construction Costs in Saudi Arabia

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ABSTRACT

The Construction industry in Saudi Arabia has gone through very dramatic fluctuations since the late 80's due to the near completion of huge infrastructure projects and also due to a steep decline in the price of oil. The demand for more construction of all types, coupled with a tight monetary supply, provide the construction industry with a bigger challenge to cut costs.

This research discusses the main factors that affect the construction cost in Saudi Arabia. A survey in the Eastern province of Saudi Arabia was conducted which included 52 contractors, 19 consultants, and 13 owners. This survey resulted in finding out 42 major factors which affect the construction cost in Saudi Arabia. The Severity of those factors measured by the level of importance and ranked according to the severity index of the contractors, consultants and owners indicated that material cost, incorrect planning, previous experience of the contract, contract management and poor financial control on site are the most severe factors.

1. INTRODUCTION

1.1 Background

The competition between contractors to win project bids increased significantly during the mid nineties. The Construction annual growth is about 3.8% during the period of 1990-95 (5th Dev. Plan 1995). Moreover the demand for more construction of all types that too coupled with a tight monetary supply; provide the construction industry with a bigger challenge to cut costs. However the efforts in this field are not proportionate to the demands. Consequently, substantial increases are observed in project costs.

1.2 Statement of Problem

The increase in the project cost has led to high level of economic fluctuation, and conflict between parties. It is therefore important to identify the main dominating factors leading to high construction cost so that efforts can be concentrated on those factors in order to reduce construction cost in Saudi Arabia.

1.3 Objectives

The objectives of this research can be stated as follows:

1. To identify the factors affecting construction costs of large projects in the Eastern province of Saudi Arabia. The research will also include the cost factors ranking according to contractors, consultants and owners.

2. To find the agreement ranking factors between contractors/consultants, contractors/owners and consultant/owners.

3. To test the hypothesis that contractors, owners and consultants, generally agree on the severity rank of the factors.

1.4 Significance of Study

This research investigates the possible factors affecting construction cost in Saudi Arabia, extensive Literature review, analysis through questionnaires and interviews with Construction professionals (i.e. contractors, consultants, and owners).

2. LITERATURE REVIEW

The literature review indicated that there are 31 essential factors causing high construction costs for large buildings, reported by Elinwa (1992). Similarly 13 factors were reported by Hanafi (1995). Okpala (1998) reported 27 factors. Al-Khaldi (1990) reported 29 essential factors, and by combining all these factors, a total of 42 essential factors were obtained.

The forty two (42) essential factors are combined into five major categories. These categories are as follows.

1. Environmental factors
2. Construction parties related factors
3. Construction items related factors
4. Cost-Estimating factors
5. Financing factors

2.1 Environmental Factors:

Construction products (Projects) are affected very much by the surrounding environment. This environment mostly affects the project cost and time.

The environment is divided into 14 divisions, which are as follows,

- Effects of weather
- Number of Construction going on at the same time
- Social and cultural impacts
- Project location
- Lack of productivity standard in Saudi Arabia
- Level of competitors
- Number of competitors
- Supplier manipulation

- Economic Stability

- Inadequate production of raw materials by the country

- Absence of Construction-cost data

- Domination of Construction industry by foreign firms and aids

- Government policies (law and regulations)

- Labor nationality

2.2 Construction Parties related factors:

The Construction processes can be divided into project conception, project design and project construction. The three main parties in the construction project are the owner (or client), the designer and the contractor.

To minimize high construction cost, overlap conflict between the construction processes should be avoided through the issuing of clear specifications, good delegation and smooth communication (Fisk 1982).

There are mainly six construction parties' related factors, which are as follows,
- Incorrect planning

- Relationship between management and labor

- Lack of coordination between designers and contractors

- Poor financial control on site

- Previous experience of contract

- Disputes on site

2.3 Construction Items related factors:

A contract must be clear and comprehensive, and must include all items, specifications, and drawings, general and specific conditions.

The factors which are related to items are as follows:

- Fraudulent practices and kickbacks
- Contract management
- Additional work
- Duration of Contract period
- Contractual procedure
- Frequent design changes
- Inadequate labor availability

2.4 Cost Estimating factors:

Estimate is a statement of the approximate quantity of material, time, or cost to perform construction. The purpose of the estimate is to provide relevant information for construction decisions. The information related to construction decisions includes procurement and pricing of construction, establishing contractual amounts for payment, and controlling actual quantities by project management.

The factors related to estimation are as follows:
- Cost of materials
- Fluctuation of prices
- High cost of labor
- High cost of machinery
- High cost of machinery maintenance
- High transportation cost
- Insurance cost
- High interest rates charged by banks on loans received by contractors
- Long period between design and time of tendering
- Bureaucracy in tendering method
- Waste on site

- Wrong estimation method

2.5 Financing factors:

The tight monetary supply in the construction industry in Saudi Arabia makes a new hard obstacle for contractors. Consequently, Contractors must now look to the financial markets for construction funds, where in the past interest-free government loans – in the form of large advance payments – were available. (Al- Dulaijan and Steven 1989).

The most significant factors related to financing in Saudi Arabia are:

- Mode of financing, bonds and payments.
- Inflationary pressure
- Currency exchange

3. RESEARCH METHODOLOGY

3.1 Introduction

The Research methodology includes the method of approach and the sampling techniques used to measure the severity indices of the major factors affecting construction cost in Saudi Arabia.

3.2 Methodology

The method of approach used for the research is as follows:

- Literature review and personal interviews with some contractors, owners, and professionals in the construction and consulting industries.

- Development of a Questionnaire, which is the output of the literature review and personal interviews.

3.3 Questionnaire Design

The investigation is undertaken in two stages as follows:

Stage I -   The first stage is the collection of data. This stage involves literature search, field visits and interviews.

Stage II - The second stage focuses on data analysis and identification of the most relevant factors influencing construction cost in building construction.

The collection of data led to the formation of a questionnaire which was distributed to construction professionals (owners, contractors and consultants).

There are three main parts in the Questionnaire.

The First part is an introduction to explain the idea and purpose of the survey as well as the definition of the interested area of study.

The Second part contains general information questions including annual volume, specialization, experience and nationality of the company.

The third part concerns the cost factors in building construction projects.
For each question, the respondents have five options .These are, "extremely severe", "very severe", "severe", "somewhat severe" and "not severe".

3.4 Statistical Sampling:

3.4.1 Sample size

In the selection process of this research there are mainly two restrictions:

1) Restricted to large projects
2) Restricted to the Eastern Province of Saudi Arabia

Considering the prevalent factors, Quota sampling is considered desirable. "The logic behind Quota sampling is that certain relevant characteristics describe the dimensions of the population. If the sample holds the same proportion of these dimensions as the population, then other information found from the sample members will also reflect the patterns in the population. Often it is viewed as the only practical method because of cost and time consideration" (Emory 1980)

In order to find the sample size the populations of contracting parties are divided into three parts:

Population I……Contractors
Population II…...Consultants
Population III…..Owners

For Population I, the number of contractors available in the Eastern Province of Saudi Arabia is 1,941 for both public and private projects (Eastern Province Commercial Directory, 1995).

The following formula was used to determine the sample size of all contractors (Emory 1980)

$$n = (t_s/d^2)/[1 + (t_s/d^2)/ N]$$

where:

    n: sample size

    N: sample population

    t: is the abscissa of the normal curve that cuts off an area of a = 0.01 at the tails

    d: is the expected error in the expected in the estimate

    s: is the maximum standard deviation in proportion of estimation (at P = 0.5 and q = 1− p = 0.5)

After applying the formula, when the difference between n and n − 1 is insignificant, that is the stopping point. So, the total sample size is 40 contractors.

For Population II, there are 135 consultants in the Eastern province of Saudi Arabia (Eastern Province Commercial Directory, 1995). So by using the same formula the sample size obtained is 19, which is doubled for accuracy.

For Population III, only owners dealing with large projects are considered and hence the total population of owners is 88. Using the same formula, about 13 owners dealing with large projects in the Eastern Province of Saudi Arabia can be taken as sample size. For accuracy the sample size of Population III was doubled to be 26 consultants.

3.4.2 Scoring

For Scoring the options given are on a five point scale. Each factor for his case have a severity index and the severity index is calculated by the following equation:

$$I_s = \sum_{i=1}^{5} [(w_i\, x_i)/4]\, 100$$

where w_i is a constant to determine quantitative measures as an indicator of comparable responses.

The scale value of w_i assigned for each response is as follows:

A) $0 = w_i$ for "Not severe effect"
B) $1 = w_i$ for "Somewhat severe effect"
C) $2 = w_i$ for "Severe effect"
D) $3 = w_i$ for "Very severe effect"
E) $4 = w_i$ for " Extremely severe effect"

For Example, according to the severity index if all parties answer the first factor to be "not severe", then the severity index is $= 0$, which means that this factor is not relevant and the last in the rank. On the other hand, if all answers are "Extremely severe", then the severity index is $= 100\%$, which means that it is one of the most important factor and the first in rank.

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3.5 The Survey

For this Survey a total of 280 questionnaires were distributed. Out of this total, 84 questionnaires were received and analyzed. The percentage of respondent was about 30%.

4. DATA ANALYSIS

4.1 Statistical Methods

The following statistical methods were used for the analysis of the data collected:

- Ranking
- Statistical techniques
- Correlation
- Cross Tabulation

4.1.1 Ranking

The Ranking of the main factors affecting the construction cost is done by severity index. The Questionnaire responses and the ranking of all professionals combined, contractors, consultants and clients are shown in the following tables.

The Categories involved in the Ranking tables are more or less the same for all the three parties. The combined ranking also involves almost the same top ten factors. Hence these factors are probably the most important factors of all the 42 factors.

The factors such as Cost of materials and Incorrect planning owns the second position respectively by the Combined parties, Contractors and the Owners, which indicate that they are probably the most significant factors of all the ten.

Table 4.1 Combined Ranking of Top ten factors

Rank	Cost Factors	Severity index (%)
1	Cost of materials	81.55
2	Incorrect planning	75.00
3	Previous experience of the contract	69.64
4	Contract management	69.21
5	Wrong method of estimation	67.63
6	Lack of coordination between designers and contractors	66.46
7	Poor financial control on site	65.74
8	Relationship between management and labor	63.75
9	Project financing	61.28
10	Economic stability	61.04

Table 4.2 Contractors' Ranking of Top ten factors

Rank	Cost Factors	Severity index (%)
1	Cost of materials	79.81
2	Incorrect planning	74.00
3	Contract management	70.00
4	Wrong method of estimation	68.75
5	Previous experience of contract	67.31
6	Lack of coordination between designers and contractors	67.00
7	Relationship between management and labor	65.00
8	Poor financial control on site	64.42
9	Cost of labor	61.54
10	Project financing	57.69

Table 4.3   Consultants' Ranking of Top ten factors

Rank	Cost Factors	Severity index (%)
1	Cost of materials	84.21
2	Wrong method of estimation	79.41
3	Incorrect planning	77.63
4	Project financing	76.39
5	Economic stability	73.53
6	Previous experience of contract	72.37
7	Contract management	71.05
8	Inflationary pressure	69.12
9	Fraudulent practices and kickbacks	67.19
10	Level of competitors	65.79

Table 4.4   Owners' Ranking of Top ten factors

Rank	Cost Factors	Severity index (%)
1	Cost of materials	84.21
2	Incorrect planning	79.41
3	Poor financial control on site	77.63
4	Previous experience of contract	76.39
5	Economic stability	73.53
6	Number of competitors	72.37
7	Level of competitors	71.05
8	Lack of coordination between designers and contractors	69.12
9	Contract management	67.19
10	Relationship between management and labor	65.79

4.1.2 Statistical techniques

The Statistical techniques include calculation of mean, standard deviation, standard error of mean, and coefficient of variation.

1. Mean = $\bar{X} = (\sum (f X)_n / n$

   where,

   $\bar{X}$ = average mean for n^{th} observation (= I_{sn})

   X_n = 1, 2, 3 & 4 (scoring scale)

   f = frequency of each observation of each factor

   I_{sn} = severity index

   n = number of observations for each factor (= 84)

2. Standard Deviation =

   $$S_n^2 = [\sum f X^2 - (\sum f X)^2 / n] / (n - 1)$$

   where,

   S_n = standard deviation for each factor

   n = number of observation for each factor (= 84)

3. Standard error of mean =

   $$S_E = Sn / \sqrt{n}$$

   Where,

   S_E = standard error of mean

   n = number of observation for each factor (= 84)

   The standard error of mean is used to describe the deviation of sample mean around the population mean.

4. 95% confidence interval =

$$\bar{X} \pm 1.96 \ S_E$$

5. Coefficient of Variation (C.V) =

$$S_n / \ \bar{X}$$

4.1.3 Correlation

By the Correlation coefficient the extent to which two variables are linearly related is measured. Three methods are used to determine the association among the parties included in this study. These methods are as follows

1. The Spearmen correlation (r_s)

The spearmen correlation is used to find and compare how well any two parties agree while ignoring the third party completely **(Barnett 1980)**
The following equation is used for the Spearmen correlation

$$r_s = 1 - 6 \sum d^2 / (n^3 - n)$$

where,

r_s = the Spearmen correlation
d = the difference between ranking for each group
n = number of factors (42)

2. The Rank Agreement factor (RA)

The Rank Agreement factor is used to measure the agreement in ranking between two groups (i.e. consultants and contractors). Following equation is used to find the Rank Agreement factor.

$$RA = \left(\sum_{i=1}^{n} | Ri_1 - Ri_2 | \diagup n \right)$$

where,

Ri_1 = ranking of group one

Ri_2 = ranking of group two

n = Number of factors (=42)

Table 4.5: Rank Agreement comparison between groups

Groups	Rank Agreement factor	Percentage agreement (%)
Contractors and Consultants	5,33	74,60
Owners and Contractors	5,62	73,24
Owners and Consultants	6,43	69,39

3. *Kendall concordance analysis (τ)*

The Kendall coefficient of concordance (τ) is a measure of degree of association or agreement among the sets of rankings. Furthermore, the coefficient of concordance (τ) is used to measure how good an agreement has been achieved amongst the respondents. In other words, (τ = 1) indicates a perfect agreement and zero indicates no agreement.

The coefficient of concordance is given by following the following equation,

$$\tau = \frac{\sum\limits_{i=1}^{k} (Ri - R)^2]}{n(n^2 - 1)/12}$$

where,

R_i = average of the ranks assigned by an individual judge to one variable factor.

R = average of the ranks assigned to the nth variable factor

k = number of judgments (=3)

n = the number of aspects of a problem or factor being ranked

$n(n^2 - 1)/12$ = the maximum possible squared deviations

The Kendall's rank correlation, $\tau = 0.868$ indicate good agreement in the ranking by all groups.

4.1.4 Cross Tabulation

Cross tabulation involves placing the survey data into tabular form (a two way table) so that functional relationship of these data can be described. The Cross tabulation was mainly used to tabulate the experience of the tested groups.

4.2 Hypothesis testing

Hypothesis testing is used in order to check whether consultants, contractors and owners generally agree on the rank of severity of construction cost factors. In this case t test was considered suitable.

The null hypothesis states that parties do not agree on the severity rank of the factors and they differ in their responses.

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As $t_{obs} > t_{critical,}$ the null hypothesis is rejected and hence it is concluded that parties agree on the severity rank of the factors and these parties are reliable in their responses.

5. RESULTS AND CONCLUSIONS

1. The five most important factors affecting the construction cost as agreed by the three sets of professionals are:

- Cost of materials (Severity index 81.55%)
- Incorrect planning (Severity index 75%)
- Previous experience of the contract (Severity index 69.64%)
- Contract management (Severity index 69.21%)
- Wrong estimation method (Severity index 67.63%)

2. The five least important factors as agreed by the three professionals are:

- Domination of construction industry by foreign firms (Severity index 31.51 %)
- Social and Cultural impacts (Severity index 31.51%)
- Insurance cost (Severity index 29.33%)
- Currency exchange (Severity index 28.72%)
- Waste on site (Severity index 23.72%)

3. Contractors have ranked the following factors to be the most severe factors affecting construction cost:

- Cost of materials
- Incorrect planning
- Contract management
- Wrong estimation methods
- Previous experience of the contract

4. Consultants have ranked the following factors to be the most severe factors affecting construction cost:

- Cost of materials
- Wrong estimation methods
- Incorrect planning
- Project financing
- Previous experience of the contracts

5. Owners have ranked the following factors to be the most severe factors affecting the construction cost:

- Cost of materials
- Incorrect planning
- Poor financial control in site
- Previous experience of the contracts
- Economic Stability

6. The Cross tabulation calculations indicates that about 50% of the Contractors that were analyzed have between 10 and 15 years of experience, also, about 75% of the owners that were analyzed have over 10 years of experience, and about 70% of consultants that were analyzed have over 10 years of experience.

7. The Kendall's rank correlation indicated good agreement in the ranking by all groups.

8. Material cost is given the highest rank of all the 42 factors. And the incorrect planning is considered to be the second major problem affecting construction cost.

6. RECOMMENDATIONS

The following recommendations are the most important ones that can be deduced by this study:

1. It is necessary that efforts should be concentrated in the major factors affecting construction cost in order to reduce the construction cost, enhance the construction performance and generate confidence within the construction industry.

2. The least agreement is between owners and consultants, it is therefore suggested that this group should sit together and resolve all possible misunderstanding and reduce gaps between them.

3. For better management and to control problems, Coordination and Communication among various parties is very important.

4. Estimates based on updated price information should be considered in order to come up with a reasonable offer and avoid any wrong estimation.

5. The pre-qualification procedure should include - as its major priority - the experience of the contractors.

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